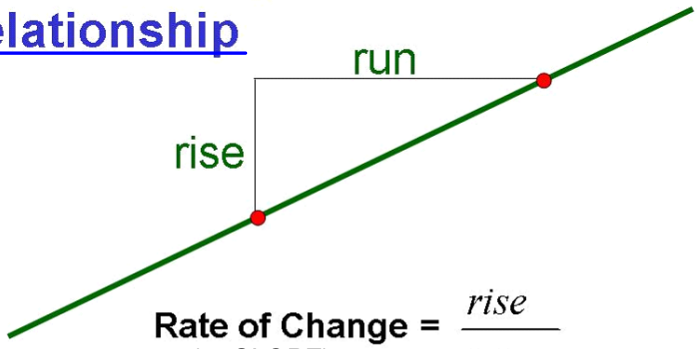
4.2 Rate of Change

L2-Rate of Change of a Linear Relationship



Rate of Change = $\frac{rise}{run}$
(or *SLOPE*)

The ***rate of change*** of a linear relationship is the ***steepness*** of the line.

Rates of change are seen everywhere.

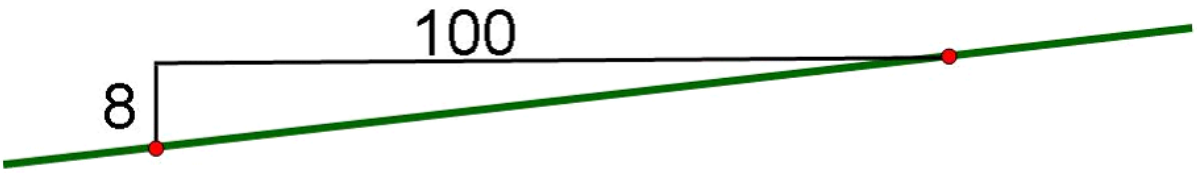
The ***steepness*** of the roof of a house is referred to as the ***pitch*** of the roof by home builders.

Give one reason why some homes have roofs which have a greater ***pitch***.

There is less snow buildup in the wintertime.

Engineers refer to the ***rate of change*** of a road as the ***grade***.

They often represent the rate of change as a percentage.

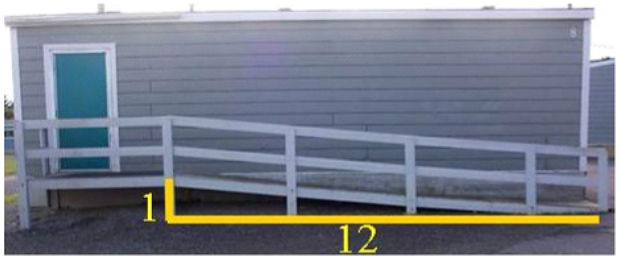


A grade of 8% would mean for every *rise* of 8 units there is a *run* of 100 units.

Rate of change = (or *SLOPE*) $\frac{8}{100}$ $\frac{\text{rise}}{\text{run}}$

= 8%

The steepness of wheelchair ramps is of great importance for safety.

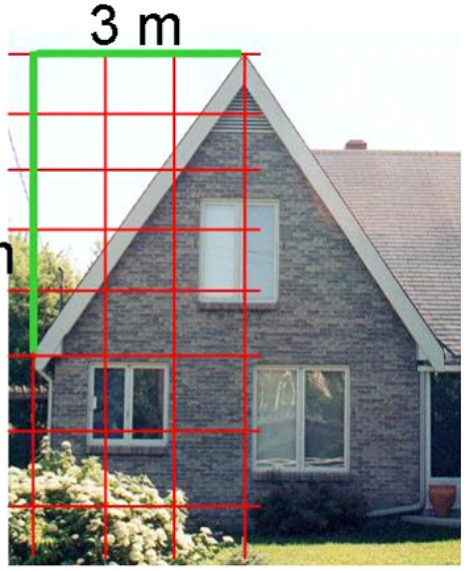


Rate of change of wheelchair ramp = $\frac{1}{12}$
(or *SLOPE*)

If the rise is 1.5 m, what is the run?

Answer: 18 m because $\frac{1}{12} = \frac{1.5}{18}$

Determine the rate of change (*pitch*) of the roof.

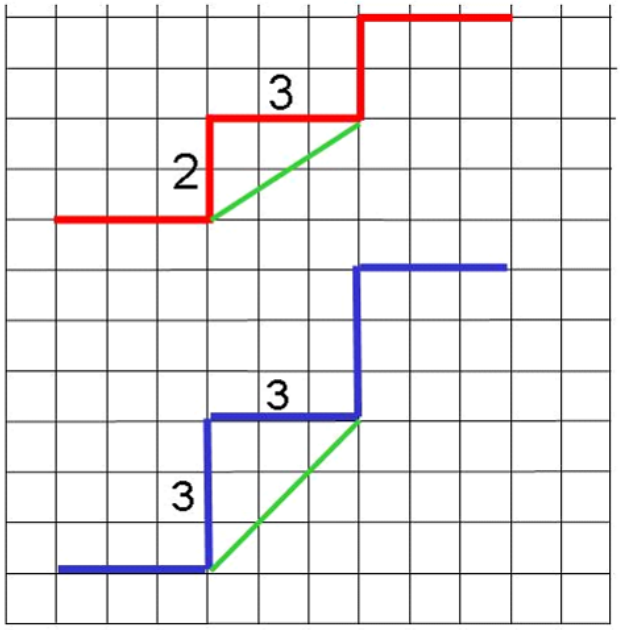


$$\text{rate of change} = \frac{5}{3}$$

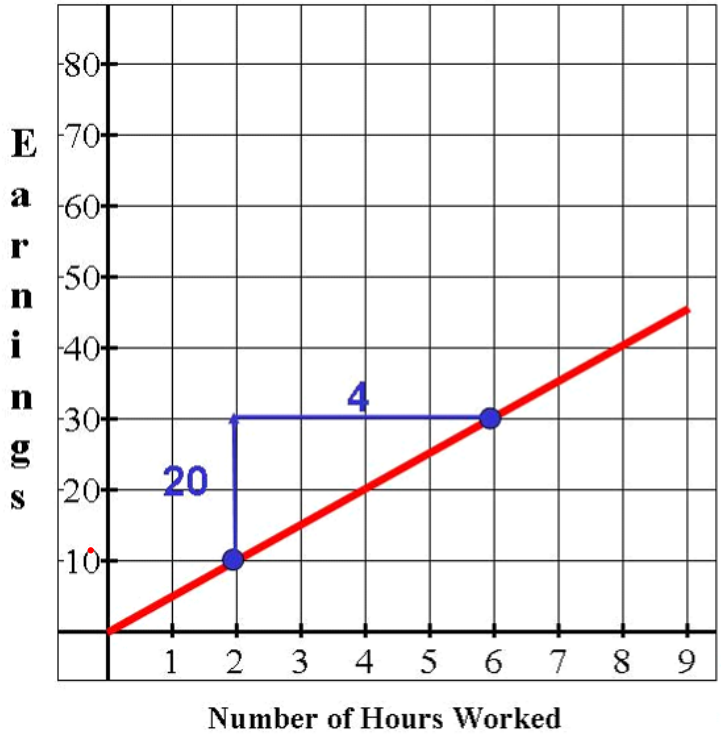
Determine the rate of change of each staircase.

$$\text{rate of change} = \frac{2}{3}$$

$$\text{rate of change} = \frac{3}{3} = 1$$



Determine the rate of change.



Which points will you use to determine rise and run?

$$\text{rate of change} = \frac{\text{rise}}{\text{run}} = \frac{\$20}{4\text{ hr}} = \$5/\text{hr}$$

What does this rate of change represent?

⇨ The hourly wage

Ramps:

Rise over Run

Types of inclines and recommendations by rehabilitation specialists

The recommended incline for wheelchair uses is 1:12.

For exterior ramps in climates where ice and snow are common, the incline should be more gradual, a 1:20.

For unusually strong wheelchair users or for motorized chairs, the ramp can have an incline of 1:10.

The steepest ramp should not have an incline exceeding 1:8.

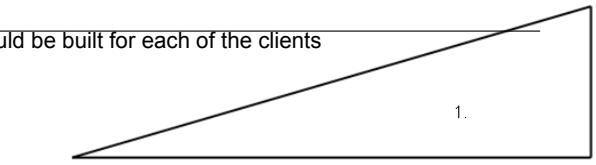
slope

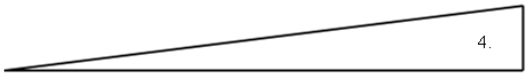
Rise (Vertical Distance)	Run (Horizontal Distance)	Rate of Change
1	12	$\frac{1}{12}$
1	20	$\frac{1}{20}$
1	10	$\frac{1}{10}$
1	8	$\frac{1}{8}$

Clients	Choice of Ramp and Reason
Client A Lives in a split-level town house. He owns a very powerful motorized chair. He wishes to build a ramp that leads from his sunken living room to his kitchen on the next level.	
Client B Requires a ramp that leads from her back deck to a patio. She is of average strength and operates a manual wheelchair.	
Client C Lives in Sudbury where ice and snow are a factor. She is healthy, but not particularly strong. Her house is a single level bungalow but the front door is above ground level. Client D Will not get approval because the design of his ramp is too dangerous.	

Building Ramps

Which of four ramps could be built for each of the clients above?



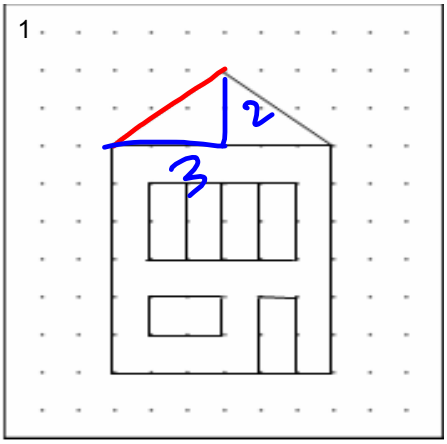


Roofs:

Calculate the rate of change (pitch) of each roof. Answer the questions that follow the diagrams.

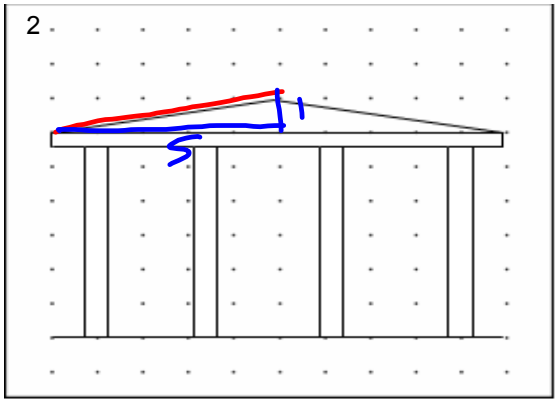
slope

1



Rate of change is $= \frac{2}{3}$

2

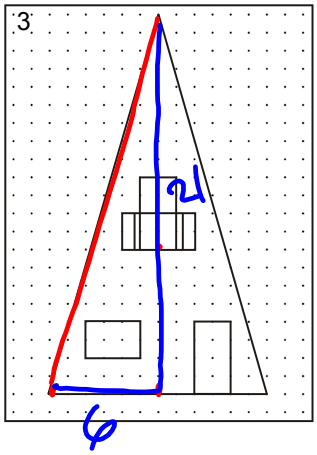


R.O.C. $= \frac{1}{5}$

Roofs:

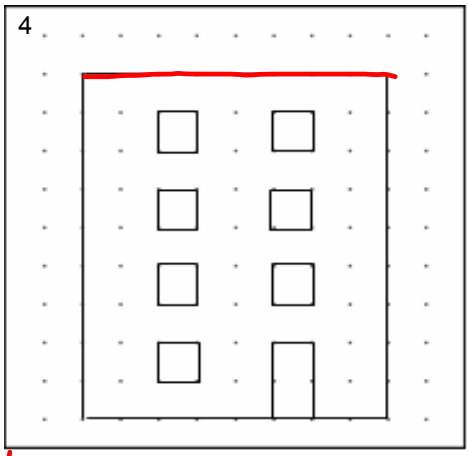
Calculate the rate of change (pitch) of each roof. Answer the questions that follow the diagrams.

3



Rate of Change (ROC) $= \frac{\text{Rise}}{\text{Run}} = \frac{21}{6}$

4



ROC = 0

1. If all four roofs were placed on the same-sized foundation, which roof would be the most expensive to build?
Hint: Steeper roofs require more building materials.

#3

2. Why do you think apartment buildings have flat roofs? What is the rate of change of a flat roof?

So snow does not fall off and hurt people. ROC = 0

3. In the winter snow builds up on the roof. Sometimes, if the snow builds up too high, the roof becomes damaged. Which roof would be the best for areas that have a large amount of snowfall? Why?

#3 because the snow will slide off.

Roads:
The inclination of a road is called "percent grade." Severe grades (greate than 6%) are difficult to drive on for extended amounts of time. The normal grade of a road is between 0% and 2%. Warning signs are posted in all areas where the grades are severe.

	Percent grade	Fraction	Rise	Run	Rate of change (decimal form)
A	1%	$\frac{1}{100}$	1	100	0.01
B	2%	$\frac{1}{50}$	1	50	0.02
C	3.5%	$\frac{3.5}{100}$	3.5	100	0.035
D	4%	$\frac{4}{100} = \frac{1}{25}$	1	25	0.04
E	5.25%	$\frac{525}{10\,000}$	525	10 000	0.0525
F	6%	$\frac{3}{50}$ ×2 ×2	3	50	0.06
G	10%	$\frac{10}{100} = \frac{1}{10}$	1	10	0.1
H	50%	$\frac{1}{2}$	1	2	0.50
I	75%	$\frac{75}{100} = \frac{3}{4}$	3	4	0.75
J	33.4%	$\frac{1}{3}$ ×20	1	3	0.34
K	40%	$\frac{2}{5}$ ×20	2	5	0.40
L	8.25%	$\frac{8.25}{100}$	8.25	100	0.0825

WARNING SIGNS

Roads:

The inclination of a road is called “percent grade.” Severe grades (greate than 6%) are difficult to drive on for extended amounts of time. The normal grade of a road is between 0% and 2%. Warning signs are posted in all areas where the grades are severe.

Which of the roads, A–L, would require a warning sign?

E to L

Some of the values in the table are fictional. There are no roads that have grades that are that severe. Which roads, A–L, could not exist? Explain your reasoning.

G to L fictional

Describe a road with a 0% grade.

Flate = No slope on grade